

FIG. 1

SOLDER BALL THERMAL CYCLING FATIGUE TEST DATA

| ROW | SAMPLE SIZE | CHIP SIZE (mm x mm) | ORGANIC SUBSTRATE PAD DIAMETER, D ₂ (mm) | CHIP PAD DIAMETER, D ₁ (mm) | D1/D2 | S1/S2 | SOLDER BALL HEIGHT (μm) | DISTANCE (EDGE) FROM SOLDER BALL CENTERLINE TO CHIP EDGE (μm) | NO. OF CYCLES TO 50% FAILS | FIRST CYCLE TO FAIL |
|-----|-------------|------------------------|--|--|-------|-------|----------------------------------|--|----------------------------------|---------------------------|
| 1 | 47 | 8.7 x 8.7 | 160 | 140 | 0.88 | 0.77 | 110 | 230 | 13260 | 2500 |
| 2 | 30 | 8.7 x 8.7 | 155 | 140 | 0.90 | 0.81 | 110 | 100 | 8430 | 2500 |
| 3 | 19 | 8.7 x 8.7 | 160 | 140 | 0.88 | 0.77 | 110 | 100 | 7963 | 2500 |
| 4 | 75 | 7.68 x 7.68 | 160 | 100 | 0.63 | 0.40 | 100 | 100 | 3250 | 600 |

FIG. 2

AVERAGE SHEAR STRAIN VERSUS DISTANCE (D_C) BETWEEN
CENTER OF CHIP AND CENTERLINE OF C4 SOLDER BALL

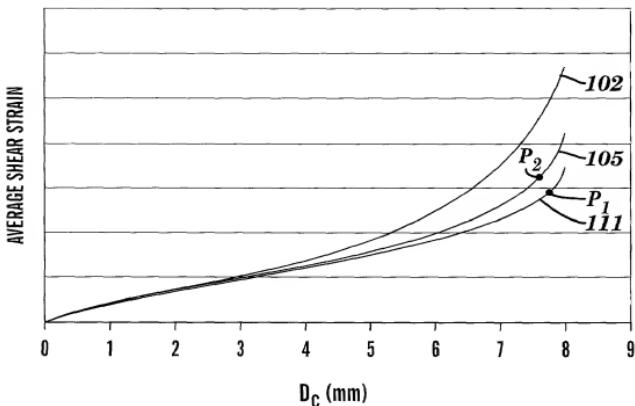


FIG. 3

AVERAGE AXIAL STRAIN VERSUS DISTANCE (D_c) BETWEEN
CENTER OF CHIP AND CENTERLINE OF C4 SOLDER BALL

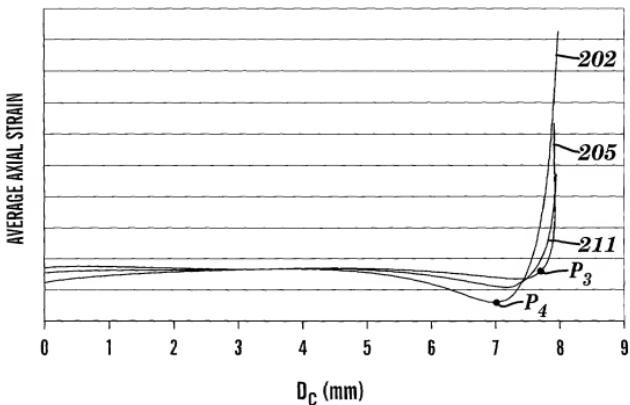


FIG. 4